vegetables of the ocean and of the earth; and to this cause is chiefly to be ascribed the multiplication of the varied chains of animal and vegetable existence, the continued spontaneous production of species, their gradual or sudden changes, and the sudden and total extinction of many peculiar and extensive tribes and families. Thus the oak, the monarch of the British forests, transplanted to the rank soil of Bengal, degenerates into a miserable stunted shrub, and the giant banyan of that country, a forest of itself, when introduced into our greenhouses, becomes the ornament of a garden-pot. Again, the vine loses its fruitfulness in the one country, the mango, the tamarind, and the plantain, cannot exist in the other. Again, even under the same latitudes, a similar diversity prevails. Excess of heat, without moisture, causes the earth to lie bare and desolate, and to remain desert for ages; excess of heat and moisture produces rank fertility inimical to humanity, but favourable to the generation and multiplication of immense varieties of animal and vegetable species: moisture, without heat, is entirely wanting in the power to generate life. The same law governs the distribution of animal species; the marked affect of temperature, dip, and inclination, is manifest in and throughout the ocean: thus the lime-secreting polypes can only exist within or near the tropics, and species become more beautiful and more abundant as they approach towards the surface waters. Within the seas, disposed under the northern and southern hemispheres, the polypes are generally wholly divested of their calcareous covering, and all kinds of molluscous animals are less supplied with this material, the pearl oyster, and many other species, wholly disappear, and those which remain appear to be shorn of their fair proportions. Every region boasts its peculiar organic phenomena: it is the same on dry land; the lamma loves its Peruvian heights; monkeys, elephants, buffaloes, rhinoceruses, hyænas, all have their climates marked out—all exist by sufferance of temperature and association alone, the boundary of their existence being fixed and permanent.

This law of nature is carried into and directs the formation of the fossil and mineral kingdoms—the preservation, change, or destruction of the one, and the generation of the other, depending upon temperature and association; the nature of the fossil beds is determined by the nature of species locally disposed, or of motions locally manifest; and the nature of the fossil bed and of atmospheric action, locally exercised, determines the after changes of the fossil into the mineral aggregate: thus to the varied phenomena of life we are indebted for the equally varied fossil formations, and consequently for those peculiar earths, mineral bodies, and gaseous products, which, in totality, form the superficial crust of the earth. But although the coral formations of tropical seas have no analogy in northern seas, the forests of India and South America have no analogy in the forests of Europe; still, formations analogous to the one and the other, are to be found in the lands of the north, and constituting its elevated and inhabitable parts.

Lands disposed within the tropics abound with gems, precious stones, the most valued metalline bodies, and the most highly crystalline rocks: but, as we approach the polar circles, these phenomena either wholly disappear, assume a marked character of climate and association, or else they exist as unerring witnesses of causes of effects no longer manifest in these latitudes. Silicates are common to all countries, but local temperature and association are co-operative causes of species being produced; thus also of the phenomena of common flints in this country, of the jaspers of Egypt, the bole of Turkey, the porcelain clay of China, the diamonds of Peru, the East Indies, Borneo, and Malacca; the gold of Africa, the quicksilver of Spain, the platina of the Oral Mountains, and of Oriental and Occidental gems. In all warm latitudes the act of change is so exceedingly strongly marked and well defined, that it appears a matter of wonder, modern men of science should be entirely ignorant of these changes: all rocks, stones, and earths, subject to atmospheric action, undergo changes in conformity to the nature of their material, and the force of heat alone, or heat and moisture acting upon them: while fossilizing, we behold organic bodies go through the process of oxidating, which process consists in the fixation and absorption of vital air by combustible bodies, and the decomposition of atmospheric air by these bodies. The vital air is the body acting, the fossil or combustible body is the patient acted upon, and having the capacity to receive, and by the force of affinity and cohesion to retain, this elastic gaseous element in certain proportions, to fix it, and to cause it to assume a solid form; the vital air thus precipitated imparting its calorific power to the compound with which it unites; and thus distributed, the calorific passes into the latent form; saturated *per se* with oxygen, the fossil body being in charge a thing of another nature, having undergone a re-arrangement of its atomic particles. But this change is far from being permanent, for local influences cause further changes, by which its primary organic form and qualities become wholly obliterated as they pass by transition into the mineral kingdom: thus silicious bodies, consisting of two or more earthy constituents, under certain atmospheric influences, give up those compounds, or otherwise a further remodification of their atomic constituents takes place: the common flints and pebbles of this country, if exposed to local tropical influences, would soon become things of another name; for, here exposed in the beds of shallow streams, the grosser earths are in the course of time abstracted from the silica, or silica-aluminous base, and the silicic base is gradually converted into pure crystalline quartz, amethyst quartz, topaz, agates of varieties, and other beautiful products, known and valued as precious stones. Exposed upon the surface soil to direct atmospheric action, the changes are in conformity to the nature of the action exercised upon them; thus the coarse silicious pebble becomes converted into cornelian, the silicious sands and aggregates become transparent or crystalline—jacinth, carbuncle, and garnet; or having an aluminous base, as sapphire, ruby, emerald, crysophrase, &c.: thus every region has its peculiar mineral products, the nature of the compound being determined by local temperature and association. The most beautiful marbles are the oriental and occidental, the most sonorous siennites, marbles, and porphyries, are found in the rainless regions of Egypt; and even in the mild temperature of Italy, the ignorant quarrymen, taught by experience, are guided in their choice of quarries by the peculiar dip and inclination of the beds, a southern aspect being always found to develop the most valued kinds of marble.

As regards the metals, although generated in many regions of the earth by electro-chemical action within the lower beds, yet it is apparently palpable that the causes of effects may in numerous instances be ascribed to the immediate action of the sun upon the earth. In temperate or cold countries metals are generated within the bowels of the earth, embracing in local extent the several beds in which their elements exist; but in Asia, in Africa, and other portions of the globe, they are almost invariably found superficially disposed; and where generating, as in the deserts, they are generated on the surface so fast as the inflammable bodies of which they are a compounded become saturated with oxygen. Gold is most abundant in hot regions within the tropics, and is generally found united with iron, emery and aluminous earths, or gypsum—the latter being in Western Africa converted into red marble. Elevated regions are always more abundantly supplied with metallic veins than plains, because the conditions of their generation are internal heat constantly supported, and supporting electro-chemical action; it is therefore requisite that the lands be drained of their superfluous waters, which, where present in quantities, form weak solutions with the acids, and thereby destroy their chemical powers. The metalliferous regions are therefore disposed in the high lands of South America, India, and Birmah, or in low lands, where rains are infrequent and the atmospheric heat very great.

It is not denied that orient gems and gold are found disposed within the soils of Europe, and that even in the British strata we find the most beautiful crystalline products, and the precious metals: thus the elevated regions of Scotland are analogous in composition and character to the Cithaut or hill regions of Northern India, the one and the other abounding with calm, gorums, agates, cornelians, &c. The Wicklow mountains also contain gold, and marbles are very abundantly diffused over the United Kingdom; gold is also found in Germany, and silver in Spain: these are facts well known; but, still, the question remains unanswered as to whether the causes of effects thus manifest to us exist in the present day. Geologists will tell you that the causes which produced crystalline rocks, gems, and gold, do not exist at present in our northern hemisphere, and that the causes of the phenomena of crystalline rocks have ceased from over the whole earth. Is this the fact? Most assuredly it is not; else why those local dispositions of peculiar species? Why this uninterrupted disposition of sedimentary beds scattered over the surface soil, which include and pass into crystalline bodies? Why should the most beautiful mineral productions be confined to the superficial beds of the earth? Why should bodies and aggregates of bodies become more highly crystalline as they approach or cover the surface of warm and tropical regions: Can the geologist, rooted to his native soil, to bygone prejudices and fashionable theories, explain why beautiful marbles, sonorous granites and porphyries, basalts and siennites, are never found disposed in the lowest beds? The singular simplicity of elements and composition of bodies composing the lowest beds has long attracted the attention of men of science, and it gave the first intimation of the progressive development of species, therein being little or no trace of animal or vegetable organization, so palpably manifest in almost all the superficial beds of the earth.

Granted that many highly crystalline rocks are often found disposed in the lower beds, and that granite often forms the basis of mountains, still it will be found that the chemical characters of granite are identified with the chemical constituents of sand, simple in the lowest beds, more complex, and branching into numerous varieties, as they are disposed on or near the surface or in the bowels of mountain; in Ceylon, Borneo, Madagascar, Africa, and many parts of Asia, the rocks of the upper series are so exceedingly confused in their mechanical mixtures, that it is an utter impossibility to classify them, and in all these regions they may be observed in various stages of formation, as influenced by atmospheric heat and atmospheric heat conjoined with water; atmospheric air enters largely into the composition of them all. On the other hand, many of the crystalline and metalline phenomena of European strata bear evidence in their internal structure, and the configuration of their organic remains, of having been once disposed beneath the tropics. Many of the beds of the British strata are palpably wholly composed of animal exuviæ, peculiar to warm and tranquil seas, and of species analogous to those now living and generating in the Pacific, Southern, and Indian Oceans; others are found of this material united in variable proportions with the animal and vegetable products of a like warm climate, the reliquæ of rhinoceruses, tapirs, lizards, hyænas, elephants, intermingling with arborescent ferns, gigantic reeds, palms, and grasses; the one and the other existing by sufferance of climate and association only. Is this disposition of organic remains ascribed to the carrying powers of water? If so, we turn from them to still stronger testimonials, to still more undeniable proofs of change, and changes which have taken place in the earth's plane of revolution—to hill and hill ranges of chalk formed of the bodies and comminated particles of organic bodies, to the vast limestone ranges abounding with madripores, to shell marbles and varieties of earths formed even within the polar circle. It is therefore evident that local influences ever determine local results; that the causes in active operation in one portion of the globe produce certain effects peculiar to the temperature of that portion, the sum of action and the qualities of matter determining the result; that the like cause produces the like effect; that in local transitions, causes and effects modify and in general change; many causes cease to exist in one region, and make their appearance, being re-generated, in another.

It is to atmospheric action, locally or generally exhibited, that we are indebted for many singular and apparently inexplicable phenomena; rocks are the products of slow combustion, or rather they are oxydated bodies, their oxygen being abstracted from water or atmospheric air; the bases of all rocks, and